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(54) Mechanical counter for a metering apparatus

(57) A metering apparatus for metering for example a medication requires a device with which the number of metering portions is displayed. The known display devices however are not suitable for a metering apparatus having two housing portions which are rotatable relative to each other. The mechanical counter for a metering apparatus of the kind comprises at least one spindle with rotary locking, whose axis extends in parallel relationship with the axis of the metering apparatus and which is disposed in the region of the peripheral surface of the apparatus. The spindle is automatically driven by way of a transmission assembly when the metering apparatus is actuated. The number of metering portions already discharged and the number of metering portions permitted in total is quasi-continuously displayed by the mechanical counter. The transmission ratio of the transmission assembly can be designed to cover a wide range. The counter serving for display purposes can be reset on the spindle. The permissible period of use of a metering apparatus which can be used for a plurality of supply containers can be reliably viewed.

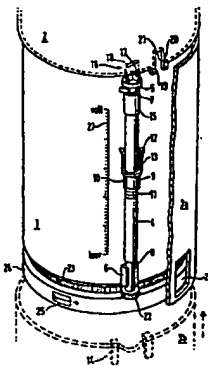


FIG. 1

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Description

[0001] The invention concerns a mechanical counter for a metering apparatus for metering powders, liquids or gaseous substances, and metering apparatus comprising such a counter. The apparatus comprises at least two housing portions which are rotatable relative to each other upon actuation of the apparatus. The number of metering portions of the substance is counted and displayed by the counter.

[0002] An aim of the invention is to provide optimum adaptation of a counter of that kind to handling of the metering apparatus in an operationally reliable manner, and to simplify manufacture of the counter.

[0003] The invention has been particularly, though not exclusively, developed for application to metered dose inhalers (MDIs) such as are disclosed in US Patent 5427844 (derived from WO/91/14645), the entire contents of both of which are incorporated herein by reference. Pressure (generally at least 50 bar) is generated in a metered amount of fluid which is discharged through a nozzle assembly having one or more very small openings e.g. in the range 25 to 500 square micrometres. Preferred nozzle assemblies are disclosed in US Patent 5478143 (and passed WO/94/07807), the entire contents of both of which are incorporated herein by reference. An empty storage reservoir, such as a spring, is preferably manually loaded e.g. by a rotary screw wedge arrangement as disclosed in US Patent 4280032 and GB Patent Application 229 113, the entire contents of both of which are incorporated herein by reference. A locking mechanism is generally provided to hold the spring in the loaded position and is manually releasable to pressurise the metered amount of fluid e.g. using a piston and cylinder arrangement. A reservoir and valve arrangement can be provided for recharging the cylinder. Further details are described in PCT/EP/96/04351 and parallel US/58 072218, the entire contents of both of which are incorporated herein by reference.

[0004] Metering apparatuses are used for example in medical aerosol therapy for dealing with ailments of the respiratory tract. In this situation a liquid or powder medication is converted into an aerosol by means of an atomiser or entrained into a stream of gas. The medication is contained in a supply container which is inserted into the metering apparatus. The supply is a container which is sufficient for several days up to some months. It is desirable to be able to display the consumed amount of medication or the amount of medication which is still present in the container.

[0005] PCT Patent Publication WO/92/01167 provides a display device for a medical metering apparatus. This display device comprises a ring which is rotatable in a controlled relationship with respect to the apparatus and which, for each dose of a medication under pressure which is taken from the metering apparatus, is automatically rotated through a predetermined angle by a wedge drive, a small portion of the ring being visible. The display device is pneumatically actuated when the medication is inhaled.

[0006] US Patent No. 4 817 822 discloses a display device for a metering apparatus, the display device comprising a linear or a rotatable disc-like scale which is disposed inside the metering device and which is moved by means of a locked wheel and a locking pawl. Only a small portion of the scale is visible through a window.

[0007] PCT Patent Publication WO/90/05381 describes a display device for a metering apparatus, which device comprises a disc-like scale with teeth on the periphery of the disc, and is rotated by means of a ball member. Only a small portion of the scale is visible through a window.

[0008] PCT Patent Publication WO/92/0324 discloses a display device for a metering apparatus in which the axial movement of the supply container within the housing is transmitted by means of a locking pawl and a worm gear to a rotatable scale of which a small portion is visible through a window.

[0009] In accordance with PCT Patent Publication WO/96/02275 a display device for a medical spray apparatus comprises a digital mechanical counter which is actuated by the movement of the supply container within the housing as well as a dose of the substance is taken from the supply container. The apparatus comprises a large number of individual parts.

[0010] A display device which is actuated pneumatically or mechanically upon displacement of the supply container, which is under pressure, in the housing of the metering apparatus, is unsuitable for a metering apparatus having two housing portions which are rotatable relative to each other and a supply container which is loosely disposed in the metering apparatus.

[0011] Ways were therefore sought of providing a suitable mechanical counter for a metering apparatus having two housing portions which are rotatable relative to each other.

[0012] The invention provides according to one aspect, a mechanical counter for a metering apparatus having two housing portions which are rotatable relative to each other, which includes at least one spindle, whose axis extends substantially parallel to the axis of the metering apparatus, and which is disposed in the region of the peripheral surface of the first housing portion in the vicinity of the rotating axis of a respective rotary member. The spindle has a tooth arrangement at the end and which is closest to the second housing portion. Provided at the edge of the second housing portion is at least one projection which engages into the tooth arrangement at the spindle and upon rotation of the two housing portions relative to each other, in order to provide good running properties for the transmission assembly, the tooth arrangement at the spindle and the projections are preferably in the form of an involute tooth configuration. Disposed on the

spindle is a cursor with rotary securing (prevention of rotation), a scale being disposed opposite same.

[0013] According to another aspect, the invention provides a metering apparatus having two housing portions which are rotatable relative to each other when the metering apparatus is operated, the metering apparatus having a mechanical counter comprising a screwthreaded spindle mounted in bearing means on one of the housing portions in a peripheral region thereof so that it is rotated by movement of the other housing portion, and a cursor movable, by the screwthread, relative to meter means, the arrangement being such that movement of the cursor with respect to the meter means provides a measure of the number of operations of the apparatus.

[0014] Preferred features of the counter and the metering apparatus will now be described.

[0015] The two housing portions are rotated relative to each other to actuate the metering apparatus. The angle of rotary movement may be a preferably integral fraction of 360 degrees; it is preferably 30 to 300 degrees. The relative movement of the two housing portions relative to each other is taken off and converted into a rotary movement of the spindle and a sliding movement of the cursor by means of the transmission assembly which comprises the tooth arrangement at the one end of the spindle and the at least one projection at the edge of the second housing portion. This rotary movement for the spindle are preferably in the form of saw-tooth mountings. The transmission ratio of the projection-type transmission assembly is fixed by the number of projections and the number of teeth on the pinion; that also fixes the number of revolutions of the spindle, which corresponds to an actuation of the metering apparatus. For each actuation of the metering apparatus the number of revolutions of the spindle can be from 1/1000 (one third) to 10. The pitch of the screwthread on the spindle is adapted to the number of revolving portions which are taken from the supply container in the metering apparatus, and to the travel of the cursor on the spindle. When the spindle is rotated the cursor on the spindle is displaced relative to the scale which is disposed for example on the first housing portion. The scale is preferably linearly divided. The position of the cursor indicates what proportion of the substance to be metered has already been taken from the supply container and what proportion is still present. The direction of rotation of the screwthread on the spindle is either in the same direction or in the opposite direction to the direction of rotation of the housing portions relative to each other.

[0016] The counter automatically comprises a display ring, at least one line having a screwthreaded portion and at least one further line with a screwthreaded portion. There are preferably a plurality of lines and the lines are preferably of a metal material. The screwthreaded portion positively lockingly engages into the screwthread on the spindle. The cursor can be displaced on the spindle

for resetting thereof, by means of the resetting projection. When the cursor is displaced the screwthreaded portion on the resilient line also rotates over the spindle screwthread without damage. The contours of the cursor and the housing are so selected that the cursor is prevented from being rotated on the spindle, by positively locking engagement. For example at least one of the resetting projections may project beyond the screwthread in such a degree that it does not pass through the gap between the spindle and the peripheral surface of the first housing portion. This projection serves as a rotary securing means for the cursor.

[0017] A recess can be provided at the other end of the spindle which is in opposite relationship to the drive portion of the spindle. As soon as the screwthreaded portion on the resilient line has reached that recess the cursor ceases to be displaced. The recess serves as a free-motion means for the cursor so that damage to the cursor is avoided if the adjustable travel distance to the cursor on the spindle is exceeded upon further actuation of the metering apparatus.

[0018] Preferably a cover can be fixed over the first housing portion to protect the metering apparatus and the counter. The cover is connected to the first housing portion releasably in an axial direction in a pre-determined position. The cover when in the condition of being fixed in position cannot rotate relative to the first housing portion. Accordingly the first housing portion can still be rotated with respect to the second housing portion although the first housing portion is covered by the cover.

[0019] The scale which is disposed opposite the cursor is provided either on the first housing portion or on the inside or the outside of the cover. The cover is transparent in a region-wise manner or it comprises transparent material.

[0020] At least one rigid restraint means may be provided on the inside of the cover, which restraint means pushes the cursor back into the starting position thereof at the one end of the spindle by means of the resetting projections when the cover is fixed into place.

[0021] Elastic restraint means may be provided in place of the rigid restraint means. In this case the resetting projections of the cursor can be provided with rigid tips.

[0022] When the cursor is reset the cursor abuts against a stop at the one end of the spindle before the cover reaches its end position. The cover is further moved to its end position, in which case the elastic portion, that is to say the resilient line or the elastic restraint means, springs back and the cursor and the restraint means are uncoupled. Accordingly the cursor is in its starting position from which it is displaced when the spindle is rotated.

[0023] In a specific configuration of the counter the pinion at the one end of the spindle has two teeth of which one oppositely disposed teeth are wider than the other two teeth. Provided on the edge of the second housing portion are two projections, between which

there is a recess in which the wider teeth of the pinion can sit. This transmission assembly preferably has a transmission ratio of half a spindle revolution to two rotations of the metering apparatus, for example half a revolution to a rotary movement of 360 degrees of the two housing portions relative to each other.

[0024] If an additional movement of for example 120 degrees of the two housing portions relative to each other is required for actuation of the metering apparatus there may be three projections on the second housing portion, more specifically being displaced through 120 degrees relative to each other. Furthermore in this case also the projections which carry a cursor which is possibly not resettable. Provided at one of the two ends of the first spindle is a gear which engages into a gear at the corresponding end of the second spindle. Disposed opposite the cursor on the spindle is a scale in a fixed position with respect to the first housing portion, which scale can be displaced either on the first housing portion or on the cover fixed thereon. In the case of the counter the total number of metering portions which have already been discharged or the total number of metering portions which are still available is represented on the displacement travel of the cursor on the second spindle.

[0025] In place of the second spindle with cursor, the arrangement may have a rotatably mounted roller, on the periphery of which a helical line is drawn with an entire revolution over the entire length of the roller. The surface on the two sides of the helical line are marked in different ways, preferably in two colours, for example red and white or red and green. In this construction the cover has a narrow window which is as long as the roller and through which a narrow strip of the peripheral surface of the roller is visible. A scale can be disposed inside the window and extends over the entire length of the roller. The scale can be divided in accordance with the maximum permitted number of metering portions or it can be divided into numbered sections according to the maximum permitted number of supply containers.

[0026] A fixed embodiment of the development of the counter has a second spindle which is of a similar design configuration to the first spindle but which is disposed at another location in the region of the peripheral surface of the metering apparatus. It is provided with a saw-tooth arrangement, similarly to the first spindle, but the transmission ratio is matched to the total number of permissible metering portions. This spindle is driven by projections at the edge of the second housing portion, preferably by the projections which are already used for driving the first spindle.

[0027] In order to provide the high stop-up ratio which is possibly required between the first and second spindles or between the first spindle and the ring gear, the arrangement may have, instead of the gear on the first spindle, a single-tooth transmission arrangement with which the gear on the second spindle or the ring gear is further rotated by one tooth for each revolution of the first spindle. The stop-up ratio can be from 2 to 1 to 10

the total number of metering portions discharged with the metering apparatus or the total number of metering portions still available, for example in a window. The ring gear is rotated through at most 360 degrees to display the maximum permissible metering portions. For that purpose, a high stop-up ratio is possibly required between the rotation of the spindle and the rotation of the ring gear, that ratio being advantageously fixed by means of a suitable scale between the numbers of teeth involved.

[0028] In a second embodiment of the development of the counter the counter includes a second spindle which may be similar to and arranged parallel to the first spindle and which carries a cursor which is possibly not resettable. Provided at one of the two ends of the first spindle is a gear which engages into a gear at the corresponding end of the second spindle. Disposed opposite the cursor on the spindle is a scale in a fixed position with respect to the first housing portion, which scale can be displaced either on the first housing portion or on the cover fixed thereon. In the case of the counter the total number of metering portions which have already been discharged or the total number of metering portions which are still available is represented on the displacement travel of the cursor on the second spindle.

[0029] In place of the second spindle with cursor, the arrangement may have a rotatably mounted roller, on the periphery of which a helical line is drawn with an entire revolution over the entire length of the roller. The surface on the two sides of the helical line are marked in different ways, preferably in two colours, for example red and white or red and green. In this construction the cover has a narrow window which is as long as the roller and through which a narrow strip of the peripheral surface of the roller is visible. A scale can be disposed inside the window and extends over the entire length of the roller. The scale can be divided in accordance with the maximum permitted number of metering portions or it can be divided into numbered sections according to the maximum permitted number of supply containers.

[0030] A fixed embodiment of the development of the counter has a second spindle which is of a similar design configuration to the first spindle but which is disposed at another location in the region of the peripheral surface of the metering apparatus. It is provided with a saw-tooth arrangement, similarly to the first spindle, but the transmission ratio is matched to the total number of permissible metering portions. This spindle is driven by projections at the edge of the second housing portion, preferably by the projections which are already used for driving the first spindle.

[0031] In order to provide the high stop-up ratio which is possibly required between the first and second spindles or between the first spindle and the ring gear, the arrangement may have, instead of the gear on the first spindle, a single-tooth transmission arrangement with which the gear on the second spindle or the ring gear is further rotated by one tooth for each revolution of the first spindle. The stop-up ratio can be from 2 to 1 to 10

to 5.
[0029] The rotary locking means for the spindle or the ring gear (i.e. the means for inhibiting unwanted movement) may be a locking pin or the rotary locking means may be in the vicinity of the spindle and the mounting or the ring gear and the rotating is in a specific configuration of the parts, for example a positively locking tooth configuration. The cursor is rotationally secured on the spindle by virtue of the positively locking contour of the cursor.

[0030] The components of the counter may consist of virtually any material. They are preferably made from plastic material, for example by an injection moulding process. For medical purposes, physiologically harmless materials are used such as for example polyethylene, polypropylene, polystyrene, polyethylene glycol (PEG) or polyethylene oxide (PEO) or polyethylene glycol (PEG) or polyethylene oxide (PEO). The materials are preferably so selected that different materials are against each other, for example PBT with Teflon against PBT or PBT against acrylate-butadiene-styrene.

[0031] The counter according to the invention can be used for example in a metering apparatus which serves as a high-pressure dispenser for a liquid medicament. The liquid to be stored is disposed in a pressure-less supply container which communicates with a metered high-pressure generating means with which an aerosol is generated; for details in this regard see German laid-open application (DE-OS) No. 1 185 361 002.5 (the contents of which are incorporated herein by reference). The device for producing the high pressure is operated by means of a spring-actuated locking stressing mechanism, the spring being stressed by rotation of two housing portions relative to each other; for details attention is directed to German laid-open application (DE-OS) No. 1 185 431 002.7 (the contents of which are incorporated herein by reference). The counter according to the invention is automatically advanced when the housing portions are rotated relative to each other.

[0032] A preferred embodiment of the invention will now be described in greater detail with reference to the drawing (Figure 1) which shows part of a metering apparatus having a counter. In this embodiment the first housing portion is rotated through 180 degrees relative to the second housing portion for actuation of the metering apparatus.

[0033] The first housing portion 1 is mounted coaxially rotatably relative to the second housing portion 2. The cover 3a which is mounted thereon encloses the first housing portion 1 and the counter. The cover is additionally shown in broken lines in the withdrawn position 3b. The number of measured portions taken from the supply container which is in use at the time is counted with the spindle (rotary shaft) 4. The spindle 4 is rotatably mounted on the first housing portion by the two support mountings 5 and 6 which act as bearings. The groove 7 which accommodates mounting 5 serves for axially fixing the spindle. The cursor with display ring 8 is provided with two radial ribs 10 each having a re-

spective screwthreaded engagement portion 11 and two meeting projections 12 on two ribs 13. The recess 8 is the free end of the cursor 8 at the end of the travel. Provided on the inside of the cover are two engagement means 14 which, when the cover is closed in position, push the cursor 8 back into the starting position at the end of the spindle by means of the meeting projections 12. When the cursor 8 is returned to the starting position 15 and the cursor is released as described above.

[0034] Disposed at the one end of the spindle is a four-tooth pinion 16 having two (radially) narrow teeth 17 and two (radially) wide teeth 18. The edge of the second housing portion carries the two projections 19 and 20 between which there is the opening 21. As described above, the teeth and projections are preferably of isovolt shape. Disposed at the other end of the spindle is the gear 22 which engages into the ring gear 23. Provided on the flange 24 of the ring gear are a plurality of numbered marks 25, of which a respective mark appears in the window 26 in the cover 3a after a given rotary movement of the ring gear.

[0035] The position of the cursor 8 against marker means in the form of the labelled scale 27 shows the number of metering portions taken from the supply container or the number of metering portions which can still be taken therefrom. When the supply container is empty a respective one of the numbered marks 25 appears in the window 26.

[0036] The described counter incorporates the preferred features of the invention discussed above (but not the second and third "embodiments" discussed above) and the description just given should be read in conjunction with earlier discussion of these preferred features.

[0037] The preferred counter according to the invention has the following advantages:

- It is automatically advanced when the metering apparatus is actuated;
- It is non-critical in terms of tolerances and is therefore reliable and easy in operation;
- The transmission can be designed to cover a wide range;
- It dispenses the number of metering portions still available, quasi-continuously and with an adequate degree of accuracy;
- It is inaccessable and cannot be displaced by release when using the metering apparatus;
- It can be used for a plurality of supply containers in succession;
- It can be produced for a different number of metering portions from each supply container and for a different maximum number of supply containers which may be used with a metering apparatus;
- It is integrated into the metering apparatus and does not require any substantial modification thereof;
- It can be produced in miniaturized form and there-

fore takes up only a small amount of space;
- The individual parts of the counter are preferably made from plastic material which operates without lubricant at a low level of friction;
- no substance can get into the substance to be metered, from the counter;
- a complete and small number of individual parts which can be inexpensively produced by injection moulding;
- It is easy to assemble;
- the counter can be reset each time a supply container is emptied, as a result the starting position of the cursor on the spindle is clearly established whenever a fresh supply container is introduced;
- the rotation of a spindle which causes the actuation of the metering apparatus during use of a supply container with a second spindle or with a ring gear means that the metering apparatus can be reliably used for a predetermined total number of metering portions or for a predetermined total number of supply containers in succession. The period of use of the metering apparatus can be reliably reviewed.

fore takes up only a small amount of space;

Claims

1. A mechanical counter for a metering apparatus having two coaxially arranged housing portions which are rotated relative to each other when the metering apparatus is operated, the counter comprising:
 - at least one spindle with a screw thread thereon,
 - whose side extends substantially parallel to the side of the metering apparatus and
 - which is disposed in the region of the peripheral surface of the metering apparatus and
 - which is mounted in the vicinity of the spindle ends with respective rotary mountings on the first housing portion,
 - a tooth arrangement at the spindle end which is closest to the second housing portion,
 - at least one projection at the edge of the second housing portion, for engaging the tooth arrangement and rotating the spindle,
 - a cursor movable along the spindle by the screwthread when the spindle rotates, and
 - a scale which is disposed adjacent the cursor.
2. A mechanical counter according to claim 1 having:
 - two rotary mountings, preferably in the form of snap-action mountings.
3. A mechanical counter according to claim 1 or 2 having:
 - wherein the cursor can be temporarily released from the screwthread for resetting.
4. A metering apparatus according to claim 21 or 22, including means for indicating the number of times the cursor has moved through its path of travel.
5. A metering apparatus according to claim 21, 22 or 23 wherein the spindle axis is substantially parallel to the side of rotation of the housing portions and the spindle has a gear thereon which cooperates with means on said other housing portion to effect rotation of the spindle.
6. A metering apparatus according to claim 24 wherein the spindle is rotated during only part of the relative rotation of the housing portions.
7. A metering apparatus according to any one of claims 21-25, wherein the counter is as defined in any one of claims 1-13.
8. A metering apparatus according to any one of claims 26-28 which is a metered dose device.

- a pinion at the one end of the spindle, which is in the vicinity of the second housing portion and which provides the tooth arrangement, and
- projections on a part of the periphery of the second housing portion, which engage into the pinion on a part of the rotary movement of the two housing portions relative to each other.

4. A mechanical counter according to claim 3 having:
 - a pinion having four teeth, and
 - two projections on the second housing portion.
5. A mechanical counter according to claim 3 having:
 - a pinion with four teeth of which two oppositely disposed teeth are wider than the other two teeth, wherein a flange of the wider teeth bears against the lower peripheral surface of the second housing portion,
 - two projections on the edge of the second housing portion, and
 - an opening between the two projections which is larger than the width of the wider teeth of the pinion.
6. A mechanical counter according to any one of claims 1 to 5 having:
 - a transmission ratio of half a spindle revolution to two actuations of the metering apparatus.
7. A mechanical counter according to any one of claims 1 to 6 wherein:
 - the pitch on the spindle screwthread is matched to the number of the metering portions and the displacement travel of the cursor.
8. A mechanical counter according to any one of claims 1 to 7 wherein:
 - the spindle has means for inhibiting unwanted movement, preferably in the form of a positively locking tooth arrangement.
9. A mechanical counter according to any one of claims 1 to 8 having:
 - at least one resilient rib with a screwthreaded engagement portion on the cursor, which screwthreaded engagement portion engages into the screwthread on the spindle.
10. A mechanical counter according to claim 9 having:
 - a recess for receiving the screwthreaded engagement portion at the other end of the spindle.

11. A mechanical counter according to any one of claims 1 to 10 having

- at least one meeting projection on the cursor.

12. A mechanical counter according to any one of claims 1 to 11 having

- a cover over the first housing portion, which cover is connected thereto rotatably in the axial direction and covers over the spindle, wherein the cover is transparent in a region-wise manner or comprises transparent material.

13. A mechanical counter according to claim 12 having

- at least one attachment means on the inside of the cover.

14. A mechanical counter according to any one of claims 1 to 13 having

- a gear on the other end of the spindle, and
- a ring gear with means for inhibiting unwanted movement, preferably with a flange, with which the gear engages, and
- which is mounted coaxially rotatably relative to the first housing portion.

15. A mechanical counter according to claim 14 having

- at least one first marking on the flange of the ring gear, which marking, after less than 360 degree rotation of the ring gear relative to the first housing portion, is disposed opposite a second marking which is in a fixed position relative to the first housing portion.

16. A mechanical counter according to claim 15 having

- a second marking on the first housing portion, or
- a window in a cover on the first housing portion.

17. A mechanical counter according to any one of claims 1 to 13 having

- a second spindle with means for inhibiting unwanted movement, which is arranged in substantially parallel relationship with the first spindle, and
- a cursor - which is possibly not displaceable - with rotary securing on the second spindle, and
- a one-tooth transmission assembly comprising
- a projection wheel at one end of the first spindle and
- a gear at the corresponding end of the second spindle, into which the projection wheel at the

end of the first spindle engages, and

- a scale which is disposed adjacent the cursor on the second spindle.

18. A mechanical counter according to any one of claims 1 to 13 having

- a roller, on which a helical line is drawn with a convolution over the entire length of the roller and the surfaces on the two sides of the helical line are marked in different ways, preferably coloured with two colours, and
- a narrow transparent strip in the cover through which a strip on the peripheral surface of the roller is visible, and possibly a scale beside the transparent strip.

19. A mechanical counter according to any one of claims 1 to 13 having

- a second spindle with means for inhibiting unwanted movement, which is arranged in substantially parallel relationship with the first spindle, and
- a cursor with rotary securing on the second spindle, and
- a one-tooth transmission assembly comprising
- a tooth engagement at the end of the second spindle, which is closest to the second housing portion, and
- projections at the edge of the second housing portion, which engage into the tooth arrangement at the end of the second spindle upon rotation of the housing portions relative to each other.

20. A metering apparatus having two coaxially arranged housing portions which are rotated relative to each other when the metering apparatus is operated, the metering apparatus comprising a mechanical counter according to any preceding claim.

21. A metering apparatus having two coaxially arranged housing portions which are rotated relative to each other when the metering apparatus is operated, the metering apparatus having a mechanical counter comprising a screwthreaded spindle mounted in bearing means on one of the housing portions in a peripheral region thereof so that it is rotated by movement of the other housing portion, and a cursor movable, by the screwthread, relative to marker means, the arrangement being such that movement of the cursor with respect to the marker means provides a measure of the number of operations of the apparatus.

22. A metering apparatus according to claim 21,

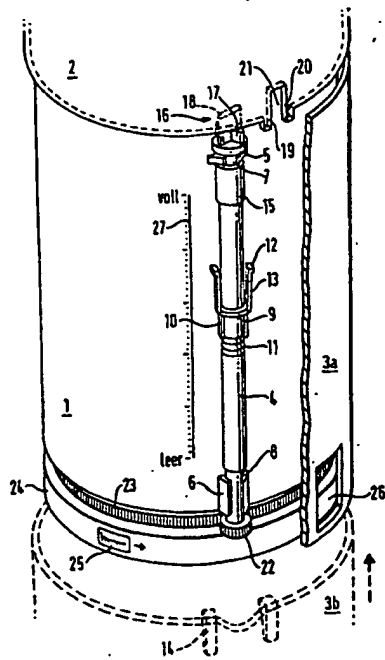


FIG. 1